14 of Figures 1A and 1B, respectively, which are generally sequentially performed and each preceded by deposition of a layer of resist and followed by development of resist layer and possibly including etching or material deposition processes between the lithographic exposures. One feature will be larger than the other and the smaller feature should be of dimensions which, ideally, closely approach the minimum feature size of interest.

Page 9, line 20+:

At the present state of the art, however, the smaller feature is generally produced with a transverse dimension of about ten microns and the larger feature is generally produced with a transverse dimension of about twenty microns. Such dimensions are about an order of magnitude or more larger than minimum feature size of the current generation of commercially available integrated circuits. Such a difference in minimum feature size puts stringent demands on processing of measurement data to hold the overlay accuracy budget within a small fraction of the minimum feature size and may provide profile shapes which are not representative of the profiles of much smaller features. The relative positions of these features and their material profiles must then be observed by optical microscopy, SEM or AFM in separate processes and the resulting data processed. All of these processes are imaging techniques and all have serious limitations. The optical microscopy method is limited in image resolution. The AFM method is a quasi-contact technique and is very slow. The SEM method requires that observation be performed in a high vacuum and transfer of the wafer and pumping an expensive vacuum chamber down to an appropriate pressure greatly extends the amount of time required for measurement to be made; which is, itself, of significant duration of about ten

seconds or more per measurement. It may be required
for the wafer to be sectioned and illuminated at
different angles requiring different set-up for
different measurements. In any case, measurement is
destructive, indirect and of necessarily low throughput
while requiring apparatus and process methodology of
high (and increasing) complexity and cost as well as
substantial processing of the raw measurement data.

Page 15, line 1+:

Figure 3 shows a plurality of peaks of light
amplitude at different frequencies or wavelengths
(calibrated as a function of 1/pixel which is basically
equivalent to inverse wavelength but specifically
related by the calibration to multiples of lithographic
tool resolution or minimum feature size). Sharp peaks
32 and broad peaks 34 are evident and are dependent on
incident geometry, reflectivity and profile of
individual lines. In Figure 3, both the sharp peaks
and the broad peaks are substantially symmetrical while
in Figure 4, substantial asymmetry is evident,
particularly in the broad peaks 42 and the sharp peaks
44 of longer wavelength. This asymmetry of peaks in
Figure 4 is due to the different spacings caused by
misalignment in the composite pattern of Figure 2B but
is substantially absent from Figure 3 since the pitch
of the marks is substantially constant. Thus, it is
seen that the shape of the spectral curve is extremely
sensitive to the existence of slight variation in
spacing of a periodic structure (which would include
features at a plurality of pitches or periodic spacings
due to any misalignment) and even small degrees of
misalignment can be discriminated by inspection and
quantified by comparison with empirical or simulated
data.

Page 16, line 28+:

Therefore, for a given feature size regime and with at least some similarity in feature geometry (e.g. pitch, width and profile) a calibration or verification of the process in accordance with the invention may be achieved by exposing overlaid patterns as described above in connection with Figures 2, 2A and 2B with differing misalignments and making spectroscopic observations such as Figures 3 and 4, followed by processing of the spectral curves and comparison to stored curves obtained from prior simulations to determine the misalignment errors. The same patterns can then be observed or measured with SEM or AFM and the results compared to the calculated misalignments. If the results do not agree, then it may be necessary to perform additional simulations to better model the composite overlay target physical properties using SEM cross-sectional data.

Page 17, line 10+:

Referring now to Figure 7, the methodology of the invention will now be summarized. Composite overlay targets 71 are obtained by superimposition of two successive mask level patterns in a reserved area of the wafer 72, referred to as an overlay measurement mark area, The second mask level is defined as a resist structure and the first mask level is defined as an etched structure on the same area of the wafer substrate.

In the claims:

Please substitute the following claims 8 and 12 for the like-numbered claim as originally filed or previously amended. A marked up copy of these claims showing the current changes is attached as an appendix to this amendment.

C6

8. (Amended)   A method as recited in claim 1 wherein said detection measures amplitude and phase.

C7

12. (Twice Amended) A non-imaging metrology apparatus comprising

   means for storing spectral curves,

   a specular spectroscopic scatterometer for measuring reflection from a plurality of marks formed by two levels of lithographic exposures and forming a periodic structure, and

   means for comparing processed signals output from said specular spectroscopic scatterometer with said spectral curves to evaluate misalignment of said two levels of lithographic exposures.

REMARKS

   Claims 1 - 12 remain active in this application. Claims 11 and 12 have been withdrawn from consideration as having been non-elected in response to a requirement for restriction in which a provisional election of claims 1 - 10 was made, with traverse. The specification and claims have been reviewed and additional editorial revisions made where seen to be appropriate. No new matter has been introduced into the application.

   The requirement for restriction has been maintained and made final. However, the traverse of the requirement is also respectfully maintained.

   The Examiner finds the previously presented remarks to be non-persuasive based on the asserted separate classification and the serious burden of examination that the separate classification is asserted to indicate. However, the Examiner has not demonstrated the propriety of the asserted separate classifications, for example, by reference to established class definitions and search notes to show divergence of mandatory search areas or, for that